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# A 'conversation' between Frank Land (FL) and Antony Bryant (AB): PART I

**Antony Bryant**[1] and **Frank Land**[2]

**Abstract**

The 'conversation' offers an important contribution to the archaeology of information systems, both in practice as an academic domain or discipline, and a focus on the genealogy of the field, including some of the accidents and deviations that marked later developments. It is derived from a series of conversations and later exchanges that I arranged with Frank Land. The substantive aspects date from the late 2017 and were then developed in a series of exchanges in 2018; although in effect he and I have been developing this conversation over many years, during which he has been continually challenging, expansive and forthcoming. Comments forthcoming from readers of earlier drafts indicated some perplexity regarding the genre and the objectives of our contribution, so it is important to note that the term 'conversation' is something of a conceit. It is not an interview per se, nor is it a biographical account. The core of what follows developed from our verbatim exchanges both face-to-face, and later via email. Some sections, however, have been reworked and enhanced to clarify and augment the issues raised. In addition, we have sought to provide a good deal of background and narrative to guide readers through the text, offering pointers to further resources. The overall contribution is intended to provide an informed and, we hope, informative contribution to people's understanding of key social and technical issues of our time.

**Keywords**

LEO computers, computing history, Frank Land, social analysis of technology, information systems history, ICTs and society

## Introduction/preamble

AB–For the past few years the Information Systems (IS) academic community has started to attend to its history and development. In terms of elapsed time, the period in question is very short – around 70 years, starting from the 1950s – but in terms of what this encompasses, it is substantial and momentous. Moreover, we are fortunate in being able to learn directly from several key figures who were involved from the beginning; who can offer first-hand interpretations. The number of accounts and other expositions has increased in the past few years, resulting in a varied and valuable resource for all concerned. Yet it is important to recognize that developing a history of IS cannot simply consist of piling up the data as an edifice recording previous accomplishments. IS academics and practitioners should certainly understand that insights do not arise merely from gathering 'Big Historical Data' and targeting it with complex analytics, leading to some ever more supposedly accurate account of the past. Expertise and acumen are required, and even these outcomes are never definitive, finished or complete; instead, they provide points in a network of accounts, sometimes conflicting, that themselves become resources for later work.

In 2013, the *Journal of Information Technology* (JIT) published a series of papers on IS history, across two editions (see Bryant et al., 2013a, 2013b). In the editorial essay to the first of these, we were at pains to challenge (1) any idea that there is a unique and distinctive 'historical method'; (2) that *history* could be understood as some linear process leading inexorably to the present. In so doing, we referred to the work of Michel Foucault. In his early works, such as *Madness and Civilization, and The Birth of the Clinic*

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(Foucault, 1967, 1976), he sought to stress the discontinuities that arise when investigating topics such as the history of madness, or practices of medical confinement. In many instances seeking to show that what for us in the present is regarded as 'necessary' and 'essential', was actually often regarded as contingent for our predecessors – and vice versa. Studying history then becomes an activity of seeking to discover 'the other', and thereby to confront ourselves.

Much as we may wish to look back on the past as something potentially familiar, Foucault stresses that we should be prepared to be shocked by its strangeness, which in turn should make us confront the present in a similar manner. This then invites the converse; what at first sight appears strange and unfamiliar, turns out on inspection to have a close affinity with some present phenomenon. For example, we might note that the role of the adjutant in military history has a bearing on our understanding of today's high-tech decision support systems. Similarly, aspects of the von Neumann architecture and the basic structure of computer programming owe a good deal to the concept of the division of labour – vertical and horizontal – that influenced Babbage in the 19th century.

Foucault used the term 'archaeology' in these works, stressing the structural aspects of history, while undermining the idea of the primacy of the individual or some form of historical consciousness or teleology. In his later work, he enhanced this archaeological allegory with what he saw as a genealogical one, explicitly using this term in the same way, and as homage to, Nietzsche's (1984) work on *The Genealogy of Morals*. If the archaeological perspective involves enquiring into the structural aspects, the genealogical one encourages us to focus on the accidental and contingent nature of developments.

> Genealogy does not pretend to go back in time to restore an unbroken continuity that operates beyond the dispersion of forgotten things; its duty is not to demonstrate that the past actively exists in the present, that it continues secretly to animate the present, having imposed a predetermined form on all its vicissitudes. . . . On the contrary, to follow the complex course of descent is to maintain passing events in their proper dispersion; *it is to identify the accidents, the minute deviations-or conversely, the complete reversals-the errors, the false appraisals, and the faulty calculations that gave birth to those things that continue to exist and have value for us*; it is to discover that truth or being does not lie at the root of what we know and what we are, but the exteriority of accidents. (Foucault, 1984: 81, emphasis added)

The metaphor of genealogy leads to a consideration of whether there are inherited organizational and cultural factors that stimulate or inhibit such developments and contingencies. Perhaps there are organizational structures from which innovations relating to information and communication systems are more likely to emerge? Lyons and Co may be one such example, as we discuss below; this is a topic to which we return in our concluding section.

Whether one agrees with and follows Foucault's reasoning, the history of IS can be regarded as a palimpsest, where the most recent or *fashionable* technological ideas and artefacts overlay all that went before, largely obscuring their predecessors and blind alleys: In some cases, masking important insights and understandings that need to be re-discovered and brought back to our attention. Re-constructing this history is then complex, open to contestation and always incomplete, owing as much to the person or persons doing the re-construction as to the material itself. This is not to undermine or diminish such efforts. On the contrary, it is crucial to gather as many re-constructions as possible as a basis upon which to build and enhance our understanding, of what went before, where we are now and what we have achieved: Also where we could and should be going.

In the light of this, what follows offers an important contribution to the archaeology of information systems, both in practice as an academic domain or discipline, and a focus on the genealogy of the field, including some of the accidents and deviations that marked later developments. It is derived from a series of conversations and later exchanges that I arranged with Frank Land. The substantive aspects date from the late 2017 and were then developed in a series of exchanges in 2018; although in effect he and I have been developing this *conversation* over many years, during which he has been continually challenging, expansive and forthcoming.

Comments forthcoming from readers of earlier drafts indicated some perplexity regarding the genre and the objectives of our contribution, so it is important to note that the term 'conversation' is something of a conceit. It is not an interview per se, nor is it a biographical account. The core of what follows developed from our verbatim exchanges both face-to-face, and later via email. Some sections, however, have been reworked and enhanced to clarify and augment the issues raised. In addition, we have sought to provide a good deal of background and narrative to guide readers through the text, offering pointers to further resources. The overall contribution is intended to provide an informed and, we hope, informative contribution to people's understanding of key social and technical issues of our time.

The 'conversation' really started in the 1990s when Frank Land, by then retired, accepted a position to join me as a visiting professor at what was then Leeds Metropolitan University (now Leeds Beckett University). In our discussions, we found we shared many ideas, but at the same time learned from each other. We collaborated in several joint papers, and I asked Frank to write an introduction to my book *Thinking Informatically* (Bryant, 2006). From this collaboration emerged the idea that the wealth of experience Frank had gained, together with our varied backgrounds and understandings of the Information Systems discipline, could provide both a historical view of the evolution of IS and a platform for further insights and considerations regarding the directions in which the discipline and associated practices could or should develop.

Frank and I view neutrality and impartiality as unwelcome and unachievable in such endeavours. Consequently, in what follows we offer a deliberately personalized and idiosyncratic interpretation of the period and key events, supplemented throughout with annotations, asides and suggestions for further reading and investigation.

We have tried to cater for a wide-ranging readership. For some of our contemporaries (60+), the 'conversation' will probably elicit additional and perhaps competing recollections and observations, providing the basis perhaps for future contributions to JIT. For others, both IS academics and practitioners, we trust that we can add something to their understanding of the characteristics of and challenges faced by those involved in the early years of commercial computing and academic IS. Given the sweep across several decades, and the range of issues encompassed by our transdisciplinary discussion, it is inevitable that many readers may feel that too much has been assumed on our part. Again, this was pointed out by some reviewers. We have responded to this by adding footnotes and explanatory sections where relevant, together with suggestions for further reading, a time-line, and list of key figures. We also address some aspects of the historical background of the period.

Yet the readership of any journal, however specialized, is always heterogeneous, and JIT is no different. Indeed, there is good reason to claim that its audience is drawn from many disciplines and interest groups, with varying forms of expertise, skills and backgrounds. Accordingly, some readers may find our additional points useful, while others find them irksome or under-developed. On the other hand, I doubt that many will have come across the work of Günther Anders, so at the very least one of our contributions will be to introduce this important but neglected writer to a community for whom his work is particularly relevant.

The result of all this is a lengthy submission, now published across two issues. Fortunately, the material lends itself readily to this bifurcation. Part 1 covers the earliest period of commercial computing and LEO in particular. Part 2 focuses initially on the development of Academic IS in the United Kingdom, and then moves on to more recent issues. Arriving at this point has involved extensive discussion of all concerned, and we are grateful to the editors of JIT for their support and guidance in the process of developing this extended contribution and bringing it to publication.

Frank Land is a unique figure in this context, combining a key role in the earliest days of commercial computing through his involvement in the ground-breaking business computer system with LEO computers in the 1950s, with his later pioneering of Academic IS, including developing some of the earliest Information Systems courses and research programmes at university level.[1] Now in his nineties, his efforts continue unabated as he engages with current developments in both areas, offering challenging insights derived from his extensive experiences. Since the late 1990s he has made many contributions describing aspects of these experiences (see for instance Land, 2008, 2010, 2015). Thus, when we started to develop and report on our recent conversation one priority was to position his knowledge and insights against current concerns; albeit after expanding upon his involvement with the LEO project, and his influential role in introducing and developing academic programmes in IS, initially in the United Kingdom, later internationally. This article should be understood as a contribution to the oral history of IS, giving voice to Frank Land's unique experiences and insights.

Interjection from FL: But the contribution is more than an oral history. As a 'conversation' its value depends on the contribution of both parties. The erudition, lateral thinking and understanding of Tony Bryant ensures that the story provides far more than a set of recollections, and provides the basis for readers to think more deeply about the nature and scope of IS.

The recollections and discussion that follow are open to supplementary and differing contributions from others, either derived from overlapping experiences or from scholarly or other forms of research and archive-based analysis, or both.[2]

Frank and I are both conscious of the ways in which 'narratives' can appear to be hermetically sealed accounts, closing off alternatives; but in fact this is never the case, and certainly is not the case in this context. In preparing and in reading accounts such as this we all need to be aware of *The Rashomon effect*.

The term derives from the film *Rashomon*, in which a murder is described by four witnesses in four entirely contradictory ways. *The Simpsons* offers a powerful and succinct summation.

> **Marge:** Come on, Homer. Japan will be fun! You liked *Rashomon*.
>
> **Homer:** That's not how **I** remember it![3]

The key *then* is to encourage others to offer their own alternative accounts of these developments, contributing to a dialogue aimed not at completion and closure, but at participation and a widening of perspectives and enhanced understanding. Frank's account needs to be understood as offering one component part of the developing re-construction of the history of IS.

FL–That re-construction is grounded in the recollection of the circumstances – personal, cultural and economic – prevailing throughout that period. My own story starts with the experience of a Jewish refugee from Nazi Germany arriving in London in 1939, being evacuated (happily) to escape the Blitz, returning to London and Grammar School, followed by study at the London School of Economics (LSE), and seeking a career first in academia but quickly followed by employment by J. Lyons & Co. Starting work as a clerk in the offices of Lyons made me aware of the difference between actual work practice, with its everyday work-arounds, against the idealised practice of the rule book, and the often deliberate time inflation of jobs permitting my colleagues to complete tasks when unexpected problems arose. Later joining the LEO (Lyons Electronic Office) team, I became acutely conscious of the confidence people had in the ability of managers at Lyons to tackle any problems. Yet at that time I was totally unaware of the role computers had played in winning the war, or indeed what the impact of computing technology was to have in transforming so many aspects of everyday life.

AB–By the early 1950s the euphoria in the immediate aftermath of the end of World War II had dissipated, and a deeper and more troublesome reckoning had started to be articulated. The enormous costs of the war and re-establishing the peace were becoming more apparent, and it was clear to many – but not all – that the UK was entering a period of decline, while the USA was making giant strides in all directions, particularly various forms of technological innovation. The prime example, of course, was the use of the atomic bomb on Hiroshima and Nagasaki, leading to severe questioning of the effects of technological advances and discussion of their use and abuse. The role of computers in the Allied victory, as Frank notes, was largely unknown, except to the few who had been involved at Bletchley Park and other similar centres in the USA.

Exemplifying Foucault's concept of genealogy, Lyons and Co benefitted from a series of accidents and contingencies that led to the development of the LEO computer. A number of their senior employees had been part of the war effort, involved in developing new technologies, particularly radar; also, the management of a munitions factory. Once demobilized they returned to work and found that Lyons was extremely fertile ground for thinking about ways in which their business could benefit from technological innovation. As Frank explains below, George Booth and John Simmons had already laid the foundation for this in the 1920s and 1930s, taking up the concept of Scientific Management promulgated at the beginning of the 20th century by Frederick Taylor, but integrating it with the Lyons philosophy of a family company.

These developments took place against a background of the rediscovery or renewed understanding of what are now regarded as some of the classic writings on organization by earlier writers such as Chester Barnard and Henri Fayol. This was in no small way due to the Marshall Plan, the US-backed scheme to rebuild Europe in the wake of World War II (WWII). The scheme was funded by US$12 billion in the late 1940s – more than US$100 billion in 2019 values – and necessitated new ideas about management and coordination. Key innovations were developed in the writings of Herbert Simon, W Ross Ashby, Norbert Wiener and others, focusing on organizational design and development, decision-making and systems approaches. A related trend emanated from the writing of Peter Drucker, regarded as the father of modern management theory.

In the same period, an alternative or complementary 'socio-technical' tradition was developing, primarily associated with the Tavistock Institute for Human Relations (TIHR) in London. Founded in 1947, the TIHR sought the

> study of human relations for the purpose of bettering working life and conditions for all humans within their organisations, communities and broader societies and to the influence of environment in all its aspects on the formation or development of human character or capacity.

The institute developed from the Tavistock Clinic, founded in the immediate aftermath of World War I (WWI) for the treatment of soldiers suffering from shell-shock and other disorders that would now be categorized as post-traumatic stress disorder (PTSD). The clinic specialized in preventive psychiatry, expertise in group relations – including army officer selection – social psychiatry and action research. A driving force was the post war need to modernize British industry and in particular to invest in technology. The TIHR with Fred Emery, Ken Bamforth and Eric Trist at the helm took up the challenge, and their early papers articulated the concept of 'socio-technical systems' exemplified by Eric Trist and K. Bamforth (1951). This was later developed in particular by Enid Mumford, a key influence on and collaborator with Frank Land (see below).

The tradition built on earlier work, particularly that of Mary Parker Follett, an American whose work was influential on writers such as Chester Barnard, and later on the development of the Human Relations School of organization design, including the work of Argyris, Lewin, McGregor and Maslow.[4]

This is an example of the palimpsest of IS history, in this case concerning the work of various theorists and practitioners studying the actual working experiences of those involved in new technologies from a systemic perspective. Something that was rediscovered in a later period, but which was better understood and more highly developed in Europe than in the United States. Thus, the socio-technical ideas referred to above found a receptive audience in many parts of Europe both in academia and in practice. These ideas have always been present in some form, but all too easily effaced or treated as nugatory, with preference given to more mechanistic and hierarchical concepts and assumptions.

At this point, offering much more detail regarding the context from which LEO and related technologies developed would take us far beyond the scope of this conversation. We have given a few indications of key issues and trends, and trust that these suffice for the moment. But it is important to note the succinct and provocative position taken by Joe Weizenbaum (1984) that 'the remaking of the world in the image of the computer started long before there were any electronic computers' (p. ix). (We return to this in our concluding section.)

The discussion that follows highlights and addresses current issues concerning academic IS, developments in ICT and more generally what might be termed 'social informatics' – or simply 'informatics' in the sense used by many of us before the computer scientists decided to take up the term in their efforts to re-brand themselves! (See Bryant, 2006). We also incorporate consideration of 'The Dark Side of ICT', a term we introduced in the late 1990s, encompassing ethical issues as well as critical consideration of the ways in which Academic IS is often far too closely associated with and uncritical of neo-liberal corporate behaviour and assumptions – for example, accepting share-holder value as the principal touchstone of success.

## Lyons and LEO

*AB–Your earliest work in the area of IT and computers was on the LEO project in the 1950s. It is now widely recognized that LEO – Lyons Electronic Office – was the first commercial computer in the world, although it still comes as a surprise to many people who assume that the USA was always at the forefront of this technology. The LEO group has made significant contributions over the years (e.g. Caminer et al., 1998; Mason, 2004; Simmons, 1962), and there is a growing and fairly extensive literature on the topic, including Georgina Ferry's highly readable book (Ferry, 2003). And now we also have 'The Information Age Gallery' exhibit at The Science Museum in London. In fact, it is only in recent years that the LEO story has gained traction, rather than being merely a footnote in the recorded history of IS, and some key accounts of the early stages of the information age fail to mention it all – for example Beniger's (1989) 'The Control Revolution' – or give it a mere passing mention – for example, Campbell-Kelly's (2004) 'A History of the Software Industry'.*

Readers interested in further resources relating to the early UK computer industry should refer to the aptly titled journal 'Resurrection', the journal of the *Computer Conservation Society* (CCS). This is a joint venture by the British Computer Society (BCS), The National Museum of Computing (TNMOC) at Bletchley Park, and the London Science Museum. The BCS has links with The LEO Computers Society, and one of their members, David Holdsworth (2016a, 2016b), has 'resurrected LEO III software by designing an emulator using Raspberry Pi'.[5]

Moreover, LEO is important not simply because it was the first business computer, but also because the entire project was a pioneering one in terms of the uses of computer technology in a large organization. It set the scene and provided the paradigm example for much of what followed, encompassing lessons that continue to be important. Indeed, as you note below, many of these have still to be fully understood and transposed into effective practice. So perhaps we can start with your recollections of why and how Lyons and Co developed LEO, and then go on to discuss the ways in which an understanding of LEO, in all its various forms and embodiments, can help us grasp important issues, particularly the ways in which current discussions and interests may be missing key points, some of which were already evident in these early days, but which have now been overlooked or forgotten.

FL–First of all it is important to understand that when we were working on LEO we were in uncharted territory; if not exactly making it up as we went along, then certainly developing our skills and clarifying issues that were not fully understood beforehand. This was not done in any haphazard sense, but we were aware that we were pioneers and using a computer in ways its inventors had never envisaged. Despite this there was little time for reflection on the big issues, such as the impact of computers on business processes and procedures. Rather we engaged in excited discussions on our latest technical discoveries in programming techniques. There was no chance to stand back and contemplate the things we had learned with regards to the application of all this in a business setting, let alone how we might do things differently or more effectively in the future. Furthermore, the lessons that we did learn from our experiences largely fell on stony ground when we sought to disseminate them, at least in the initial period in the 1950s and 1960s. Some of them are only now beginning to be fully understood and appreciated. Of many possible examples I have selected three to illustrate the point.

1. We were taught by Simmons that change was only worth investing in if it could be demonstrated that it provided a new business capability. Each LEO application for J. Lyons, exemplified by the teashop replenishment application, aimed to accomplish this with a range of technological, business process and management information innovations. Many LEO clients resisted the idea of radical change, instead opting to maintain the system as it had evolved over time, often with little relevance to the post war world, as long as the new computer technology could carry out the processes at a lower cost.
2. Innovation implies doing things in new ways, and that in turn implies uncertainty regarding the outcomes both in terms of technical sufficiency and human behaviour. We rapidly learned that designing systems even at the level of the computer programme is not deterministic and depends on often unknown factors, hence the need to use an experimental approach to design. Yet even today, much design assumes outcomes that can be predicted or modelled from the outset.
3. The time taken to implement a system frequently takes longer than our ability to forecast the changes in the environment the system will have to operate

in. The issue of planning horizons is discussed below.

*AB–So were you and the others in the team working on the early LEO project – what is now called LEO I – aware of the unique nature of the project? Did you and your colleagues at the time think that the application of computer technology in this context was something that would have far wider impact, or was the main concern limited to delivering the project to Lyons?*

FL–As time passed, we transitioned from a tight focus on making our programs work to realizing that we were involved in a project that was transforming the way business practices were organized. But we need to distinguish the understanding we coalface workers had from the very different concepts, perspectives, and agendas of those who defined the Lyons business model and strategy, and who had decided to initiate the LEO project.

I can pick out typical coalface problems faced by 1950s programmers. One was to achieve a segment of a programme which in operation would be completed in time to catch the next card or printer cycle. Shaving an instruction repeated numerous times in operation from a routine could affect the timing of an application and would be gleefully reported to one's colleagues at a coffee break. Probably the most frequently faced problem was how to shoe-horn instructions into the very limited store available. Whereas a solution to the first problem might have been to use open routines, tight loops could help to fit the programme in store. There was always the temptation to employ the Pareto principle – discard the 20% of routines less likely to be invoked but run the risk of running into synchronization problems. Other coalface problems which were of constant concern were how to cope with emergencies, including computer failure in the middle of a run, emergence of apparent bugs in a fully debugged programme and, of course, data errors.

Let me say a little about what led to J. Lyons and Co developing LEO, and the key figures involved. Lyons had grown rapidly in the first half of the 20th century (Bird, 1994, 2000; Harding, 2019). It had become Britain's largest player in the food industry with a wide range of products and services catering for a mass market. Its growth was based on the quality of its products and services, including catering for the Royal Garden Parties at Buckingham Palace and at the annual Wimbledon Tennis tournament. But equally, senior management realized that to maintain growth and profitability, the company had constantly to review its business model and its business processes. And that required high-level support staff reporting to the Board of Directors, which was made up almost exclusively of members of the founding families.

*AB–The company grew as an off-shoot of the tobacco company Salmon & Gluckstein Ltd. Its founders were Samuel Gluckstein who formed a partnership with his two sons Isidore and Montague Gluckstein. They were joined by Barnett Salmon, a tobacco salesman, who later became Samuel's son-in-law. In the late 19th century, Montague Gluckstein became interested in the idea of developing catering services, particularly for the large exhibitions that were sweeping across Victorian Britain. His partners, however, were only willing to support the venture if it did not use the company name, as they considered such ventures infra dig. Montague enlisted a distant relative, Joseph Lyons, and so the company was named J. Lyons and Co.*

FL–George Booth, the Company Secretary was one of the very few non-family members of the Board. Booth had joined as company secretary in 1890, and served until 1950s. He and the senior managers – Salmons and Glucksteins – understood the necessity to recruit well-educated employees to manage the business, and not rely solely on management trainees taken straight from school and trained in the ways of J. Lyons.

Booth was instrumental in 1923 in recruiting John Simmons, a Cambridge graduate with a first-class degree in mathematics (called a Wrangler) to join the company. Simmons' brief was to review all aspects of the company's clerical procedures to increase the efficiency in handling the growing number of transactions – many of very low value with slim profit margins, and at the same time to provide operational and senior management with the feedback to manage the company effectively in its day-to-day operations and the ability to consider the viability of new initiatives. Simmons proved to be a key figure in the expansion of Lyons from a family-based company to a nationally dominant organization.

When I joined the company in 1951, fresh from working as a research assistant in the Economics Research Division of the London School of Economics, I was assigned to the Statistics Office. I worked as part of a group keeping the accounts of several Lyons Business units. My business units included the provincial bakeries and the Lyons laboratories. (This included, unknown to me, Margaret Thatcher as a member of staff.) My group was led by a junior manager reporting to the member of the Board responsible for the business units. My job was to post all the transactions relating to the business units I dealt with to their cost accounts, highlighting any variances between actual use of material and labour, and the standard levels expected for that volume of trade. At the end of each week, the outcomes from all the business units dealt with by my group were consolidated in *The White Book* and presented by to the Board member responsible. Our manager had to point out variances and explain, from his own and his team's investigations, why they had occurred. He also had to provide the details for the particular Board member the answer to a range of 'what if' questions. These could range from the impact on the market, on costs and profits of, say, changing the recipe of cupcakes, to the possibility of introducing a new product line. The system, largely devised by John Simmons, ensured that senior management was kept abreast of the performance of their business units and were provided with the resources to look at alternative courses of action. One notable feature was the direct communication between the junior manager and the responsible member of the Board, without the intervention of middle managers.

The recruitment of Simmons was followed some years later by that of Thomas Raymond Thompson, another Cambridge Wrangler, and other high calibre management trainees who played important roles in the Lyons computer enterprise, including Oliver Standingford, David Caminer, Derek Hemy, John Grover, Leo Fantl and John Barnes.

In the early 1930s, John Simmons, by now titled Chief Comptroller of Lyons, established the Systems Research Office, as a business process think tank and business process innovator. A stream of organizational and process innovations followed, implementing much of the brief provided by Booth to Simmons a decade earlier. As a result, J. Lyons & Company gained a reputation for running a smart business, not only in its mainline food and catering business but also in ancillary services such as building the bodies of its fleet of vehicles and running its own laundries.

From the start, the Systems Research office looked for methods of automating business processes (or clerical procedures as they were then called), and carefully costing each process to enable management to compare on a week-by-week basis actual costs in terms of material and labour used against pre-set standards. Many of the ideas were rooted in the concepts of Scientific Management developed between the end of the 19th century and start of the 20th century in the United States by Frederick Taylor (1911). At the same time, they searched for ways of simplifying procedures and avoiding, where they could, the transcription of information from one document to another. Thus, a customer order form became the delivery note and finally the invoice. The systems research staff explored a variety of office technology, including punch-card machines. Some of these technologies were then introduced more widely, but only after rigorous testing proved that they could and would lead to enhanced efficiency and/or effectiveness of the process in question.

One important consequence of the work initiated by Simmons, and carried through by the Systems Research team, was that if there were to be improvements in efficiency and effectiveness, any revised systems had in some way to reinvent the specific business systems. Introducing computers could not merely replicate the previous system, perhaps at a lower cost, but had to add additional value through what were highly ambitious redesigns of the business process. Today, we talk about business process re-engineering (BPR) as if it were a new idea devised by Michael Hammer (1990) a few decades ago. Lyons practised it as their business grew in the first half of the 20th century.

*AB–This is a clear example of the people at Lyons understanding a key issue that others only caught up with much later. Hammer and others came up with the term BPR in the 1990s, largely a response to what they saw as a major threat to American economic and market dominance. In the 1990s it was Japan that posed the most serious threat. But BPR became synonymous with a macho style of management, usually associated with massive redundancies – often euphemistically termed 'down-sizing' or 'right-sizing'. Hammer's writings, such as his slogan 'don't automate, obliterate', deliberately fostered this. In the late 1970s and 1980s, however, Stafford Beer offered a far better mantra that captures the policy at Lyons in the 1950s. In 'The Brain of the Firm', Beer (1972) stated that*

> The question which asks how to use the computer in the enterprise, is, in short, the wrong question. A better formulation is to ask how the enterprise should be run given that computers exist. The best version of all is the question asking what, given computers, the enterprise now is. (p. 70)

Lyons was an organization that led the way in many aspects of organizational design, incorporation of innovation, and so on. Yet by the late 1970s the company was losing money and was acquired by Allied Breweries leading to the formation of Allied Lyons, a step that led almost inevitably to its dismantling, and eventual disappearance by the 1990s. Perhaps they did not pay enough attention to the potentially barbed nature of Beer's third question?

FL–The work of the Systems Research Office led Lyons to become involved with the Office Machinery Users' Association (OMUA) whose membership included many of the largest UK companies, including of course the business machine companies themselves. The OMUA was established in 1916 to investigate and propagate the use and potential benefits of introducing business machines into British industry. In 1936 it was absorbed into the Office Management Association (OMA), itself founded in 1932. Later the OMA was renamed the Institute of Office Management, and in 1972 it became the Institute of Administrative Management (IAM). As such its brief included defining curricula for teaching management concepts and practices, and setting qualification standards. It continued as such until 2013 when it was purchased by a Management Education organization. (NB The use of quaint terms such as 'office machinery' and 'business machines'.)

John Simmons played a leading role in the Institute, fostering the role of computers as a business tool. He was its Chairman from 1938 to 1950, also President from 1944 to 1950. Many of the early customers of LEO were members of the Institute and were motivated to accept computers influenced by the example of Lyons and the advocacy of Simmons. A good example was Mr Bradley, one of the top administrators of the Ford Motor Company at Dagenham. The result was that Ford UK employed LEO computers to run its payroll on a LEO bureau and later acquired its own LEO II computer well before the parent company in Detroit used computers for business processing (Land, 2006).

In 1947 Simmons sent two of his lieutenants, T. R. Thompson (TRT as he was known) and Oliver Standingford, to the United States to study advances in business practice that may have developed during WWII, and which could usefully be adopted at Lyons (Caminer et al., 1998: 16–19). They found little to interest them in conventional business circles, but they did come across computers when visiting Professor Howard Aiken, designer of the Harvard Mark I electro mechanical computer. A planned visit to ENIAC had to be aborted but they learned about ENIAC, and its proposed successor EDVAC,[6] from Dr Herman Goldstine at Princeton University. These visits gave them the idea that these machines, designed as they were for technical and scientific calculations, could be adapted for the kind of mass data processing used in the running of Lyons, offering a new and effective way of reorganizing the clerical procedures of the company. They even sketched out how a clerical procedure like a payroll might be organized on a computer.

They discussed these ideas with their American hosts, who encouraged them to take these ideas further. Goldstine told them that one of the most advanced computers was at that time being designed and built back in England, at Cambridge University, by Professor Douglas Hartree working with Dr Maurice Wilkes (later Sir Maurice). Further impetus in this direction was provided by a visit to the huge Prudential Insurance Company, where they learned of the company's plans to use computers for automating the premium billing of their millions of clients.

On their return to England, Thompson and Standingford wrote a report on their visit. They proposed that Lyons should acquire a computer, suggesting that such a machine could be used to speed up clerical processes, improve accuracy and, at the same time, help management make decisions. They outlined several alternatives for acquiring a computer, but noted that at that time no computer had been designed for dealing with business processes involving large volumes of data input and output, while associated with relatively simple calculations. Hence, they proposed the alternative of Lyons designing and building its own device, possibly in association with a group already building computers. (NB Simmons also looked at various other technologies at the time – including some made by IBM, but this option was deemed too expensive.)

The Lyons Board accepted the proposal and sent a delegation, including George Booth, to meet Hartree and Wilkes at Cambridge University. The meeting went well, and a proposal was quickly outlined whereby Lyons would provide a grant of £3000 (equivalent to about £90000 in 2019)[7] to the University, and Cambridge University would help Lyons design and build its own computer. Within a remarkably short space of time – just a few weeks – the Lyons Board and the University authorities enshrined the proposal in a contract which included the stipulation that a Lyons employee, Ernest Lenaerts, would join the Cambridge team, both to learn about Electronic Delay Storage Automatic Calculator (EDSAC)[8] and help with its design and implementation (Lenaerts, 1948).[9] Three weeks later, Lyons sent a cheque for the agreed amount to Cambridge University.

By 1949 when Cambridge signalled the successful operation of its EDSAC computer, Lyons confirmed its decision to build its own computer modelled on the EDSAC architecture. Following the advice of Maurice Wilkes, Lyons hired John Pinkerton, a young Cambridge research scientist as its head engineer tasked to lead the construction of what became LEO I. Pinkerton proved to be a key figure in the technical success of the LEO range of computers. He combined a talent for innovation with a practicality that led from innovation to successful implementation as well as an ability to communicate and interact with his non-technical peers. His achievements were marked in 2000 with the launch of the annual Pinkerton Lecture by the Institute of Engineering and Technology (IET).[10] Most fittingly, the first lecture was given by Maurice Wilkes.

This was a period which saw the computer industry world-wide start a rapid escalation. From a position that had seen the head of IBM, Thomas Watson, proclaim that the world would require only a handful of computers to meet all its computing needs, to the situation in which every large business, every University, Government Department and technical institute, at least in the developed world, felt the need to have access to computer power. From the handful predicted by Watson, the numbers escalated in the decade from the mid-1950s onwards to many thousands. Exploiting the opportunities opened by the power of computers required a cadre of professionals ranging from engineers to design, build and maintain the machines, to those who designed the systems, prepared the computer programmes and those who operated them. Professional institutes to create these new professions were set up in many countries. In America, the ACM – Association for Computing Machinery – as well as the existing IEEE took up that role. In the United Kingdom, it was the Institute of Electrical Engineers (IEE now IET), but more importantly, the BCS which sought to establish a computer profession akin to the medical profession. Although always influential, it never achieved the exclusivity and regulatory powers of the professional medical bodies, and today, many more computing professionals are not members of the BCS than have membership. Nevertheless, it is the BCS which represents the United Kingdom on the International Federation for Information Processing (IFIP), which itself represents these IT professions world-wide.

The LEO teams acquired confidence from the success of the Lyons applications such as the well-known *Teashop Ordering System* (Land, 1997) and were receptive to the notion from Simmons, Thompson and Caminer, that computer applications would only add value if the existing business processes were rethought. But many customers were far more reluctant to change systems they had got used to and thought they understood. This difference in approach led to a kind of arrogance in the LEO teams, which later made the take-over by English Electric (EE) more problematic. Many of the LEO leaders had to take second place to EE personnel to whom they felt themselves superior. The barbarians had triumphed!

*AB–Can you clarify the term 'customers' in this context?*

FL–I mean the senior management of customers for LEO. A typical example was W. D. and H. O. Wills, the cigarette maker – manufacturer of *Wills' Woodbines* and *Capstan Full Strength*. They had developed a complex pricing mechanism, involving different prices for different classes of customer. This had become increasingly complex as time passed, but its rationale forgotten. LEO people questioned the validity of this but were rebuffed.

*AB–The disappearance of LEO was then bound up with the sorry tale of the demise of the UK computer industry.*

FL–The take-over of LEO by EE was part of an ongoing process of the rationalization of the fragmented UK computing industry. It culminated, in 1968 in the Government-sponsored (Ministry of Technology) merger of much of the British Computer Industry into ICL.[11] But the rationalization was only partial. The computer suppliers working primarily for the Ministry of Defence held out against a single all-embracing computer company. Consequently, the defence computer divisions of EE (the Marconi part of EE LEO Marconi), Plessey, GEC[12] and Ferranti were merged into a separate group independent of ICL. Thus, a great deal of expertise, especially associated with real-time control systems, much of it at the frontier of computer applications and design, was lost to ICL. I believe this held back the possibility of long-term success for ICL in particular, as its main competitor, IBM, covered all bases, from acting as a contractor to the US defence industry working on the latest scientific advances to serving the business community from the largest corporation to the corner shop. In the event ICL survived as an independent entity for a few decades before it too lost its independence as it was acquired by Standard Telephone and Cables in 1984. This was not a success, and the company was fully taken over by Fujitsu in 1998 which finally closed its ICL division in 2008. The other Government sponsored group that comprised the defence-oriented suppliers thrived for a couple of decades and expanded quite considerably, but in 1985 Marconi closed and through the 1990s the group declined to nothing.

*AB–This decline and ultimate demise of the UK computing industry in many ways parallels the histories of various other technologies; where the UK took an early lead, based on innovative breakthroughs and pioneering efforts that were then dissipated and squandered. The obvious example is TV. The 'received wisdom' or conventional view is that these failures, and the subsequent successes of the Japanese and particularly the US computing and electronic industries, were due to a failure to foster private sector entrepreneurialism. But as J K Galbraith observed 'The conventional view serves to protect us from the painful job of thinking'.[13] In fact, the role of the public sector and the state is critical, albeit deliberately ignored or obscured, so that the entrepreneurialism and risk-taking of the private sector can be heralded and lauded. The irony is that although the US is regarded as the redoubt of venture capitalism and entrepreneurialism, many of their most successful corporations have benefitted enormously from state funding and support.[14] Mariana Mazzucato has pioneered research on 'the entrepreneurial state' in recent years; notably including the example of the largely publicly-funded technological breakthroughs that were critical in the development of the iPhone (Mazzucato, 2013). This is not simply to engage in political point-scoring, but rather to emphasize the complexities involved in the process of innovation, and what has been termed the move from 'competence' to 'performance' (Winston, 1998). Regarding TV and commercial computing, the UK swallowed the myth of the value of the private over the public sector. It continues to do so, exemplified in David Cameron's attack on the 'enemies of enterprise' – i.e. the public sector – while extolling the enterprise of the private sector. We have already alluded to the way in which Academic IS has become too intimately linked to corporate interests and concerns such as 'share-holder value', and we shall return to this in a later section. In the US this connection was evident from the start given that the early texts and university departments were termed Management Information Systems (MIS).*

> In the UK things took a different turn, with a unique and bizarre British characteristic. The BCS may be at best only a minor presence in the UK computing and IT industry, but if the 'great and good' of the ICT industry did not manage to develop the BCS to the anticipated extent, they did manage to insinuate themselves into the livery companies of the City of London. 'The Worshipful Company of Information Technologists' was established in 1992, complete with its coats of arms and Latin motto. (It is also one of the few modern livery companies with its own hall, construction of which was made possible by several generous donations, particularly one from Dame Stephanie Shirley, founder of F International – see below.) There is something ironic, and perhaps very British, about this; a group of people closely associated with leading-edge technologies, with enormous social, political, and economic ramifications, enthusiastically participating in something that harkens back to the guilds of the middle ages, but whose impact on practice (and policy) can at best be described as slight or even nugatory.

FL–Lyons were clearly very fortunate and prescient in their early recruitment, particularly since brilliant mathematicians are not always the best people to develop people-centred systems! Senior management at Lyons were something of a breed apart in their ideas about use of this technology, they wanted far more than speedy statements of profit and loss, as they understood that decisions at board level would be greatly enhanced with better quality and well-focused reports and information.

The 1947 report produced by Thompson and Standingford presented several options. I refer to these in my paper in *Review: The Technical and Social History of Software Engineering* (Land, 2015), also in my chapter *Implementing IS at J. Lyons* (Land, 1999). The best account can be found in Caminer et al. (1998, particularly pages 20/21 and 337–359).

There were five options put to the Lyons board:

- One was to provide financial support to Hartree at Cambridge University to pursue his work and influence its direction for the benefit of Lyons as a company.
- Another was to put the idea into the hands of a large electrical company and leave them to exploit the outcome.
- A third was to collaborate with Electronic Controls Inc. in Philadelphia, learning from the example of Prudential Insurance.
- A fourth was to approach the British Government to coordinate research to retain leadership in the field.
- The final option was to 'build a machine in our own workshops drawing information and advice from Cambridge and Harvard Universities'.

*AB–You mentioned in our discussions that one key issue in the immediate post-war era concerned the feasibility of developing a working stored-program computer. Computer technology had of course been enormously important in the war effort, but the use of the technology in wider contexts was altogether a different matter. The Colossus computers used at Bletchley Park to decode German cyphers were programmable but could not store the programs, instead requiring vast arrays of switches and plugs. These needed to be reset and checked every time any program was run. A team at Manchester produced what is now regarded as the first stored-program computer, using von Neumann's model (the Von Neumann Architecture), but this was a very small-scale, experimental venture designed as 'proof of concept' rather than for productive use. Von Neumann's model quickly became the de facto standard, although there were other contenders such as the Harvard architecture, which used different memories for data and instructions. Von Neumann's model integrated both, being developed from Turing's (1936) classic paper of 1936 'On computable numbers', which first proposed this approach.*

The Wikipedia entry offers the following:

> The Manchester Small-Scale Experimental Machine (SSEM), nicknamed Baby, was the world's first stored-program computer. It was built at the Victoria University of Manchester, England, by Frederic C. Williams, Tom Kilburn and Geoff Tootill, and ran its first program on 21 June 1948

Other accounts credit EDVAC as the first stored programme computer; EDVAC being derived from ENIAC.

> Von Neumann wrote up an incomplete set of notes (First Draft of a Report on the EDVAC) which were intended to be used as an internal memorandum – describing, elaborating, and couching in formal logical language the ideas developed in the meetings. ENIAC administrator and security officer Herman Goldstine distributed copies of this First Draft to a number of government and educational institutions, spurring widespread interest in the construction of a new generation of electronic computing machines, including Electronic Delay Storage Automatic Calculator (EDSAC) at Cambridge University, England and SEAC at the U. S. Bureau of Standards.

So, the Von Neumann architecture was accidental![15]

FL–But in fact both EDSAC and SEAC[16] were, unlike Manchester's 'Baby', designed to serve proper users. The issue of a stored program computer was resolved in 1949 when EDSAC I was demonstrated, and Lyons then gave the go-ahead for developing LEO. LEO I was ready by November 1951.

*AB–So when and how did you join the LEO team?*

FL–I joined in late 1951. I had studied at LSE (The London School of Economics) for my first degree, and then became a research assistant there. In late 1951 I joined Lyons as a clerk in the statistics office. The first people recruited for the LEO team were selected from those already working for Lyons. Before joining LEO, all candidates had to attend a one-week aptitude test, though it was merely called an appreciation course. We learned the rudiments of computers and how such a machine could be programmed. I found the course very difficult and agonized over the homework we were assigned. But working through it with my wife, Ailsa, I managed to pass. (Ailsa Land, at that time a lecturer in Operational Research (OR) at LSE; subsequently Professor of OR at LSE.) As I remember only two of those attending passed; Mary Blood, later Mary Coombs, and myself. I was among a group of around 6 people who were essentially the second generation, joining those who had pioneered LEO I. It is important to understand that at this stage no-one really understood what was involved in recruiting people to such endeavours, and the recruits themselves probably had little or no idea where this all might lead! There was a naïve view that various technical and other skills were important, but hardly anything more profound. Interestingly Simmons and his colleagues recognized from early on that the key to understanding computers lay not in a facility with mathematics – though it was regarded as a useful rather than essential skill – but in a systematic approach to problem solving. It was only as the work progressed that people came to realize the actual skills that were relevant and essential to the project. Also, not everyone who was approached wanted to work on something as uncertain as the LEO project. For example, some of those gaining a position as a management trainee at Lyons saw this as opening the door to a promising and lucrative career, with excellent prospects for promotion and high levels of executive responsibility; why move away from this into an unknown area with, at best, an uncertain future?

*AB–Were there any other women among these early intakes?*

FL–There were very few women. The best known is Mary Coombs, who as Mary Blood, was the daughter of the Lyons Medical Officer, and herself a Lyons' employee. She attended the same appreciation course as myself, and joined the LEO programming team just a little before I did. She had a degree in languages from Queen Mary College after attending St Paul's school. Her story is recorded in the Oral History collection, *Other Lives*, at the British Library.[17] Another notable example was Betty Cooper (née Betty Newman) who became a member of the programming team I led. But I was not aware of any discrimination based on gender, and the LEO team had a handful of women amongst its programming staff, but they were very much a minority.[18]

*AB–The entry in LEOPEDIA records that*

> Betty joined Lyons as a labour cost clerk in the Statistical Office in September 1949. In 1953 she was selected for a LEO appreciation course, and as a result was offered a job as a programmer on LEO I. Despite scepticism about what LEO would be able to do she accepted the offer. She worked on a number of applications – payroll under Mary Blood (Coombs) and Tea Blending under Frank Land. She gained a reputation as a sound and reliable programmer. She left LEO to work as a programmer with EverReady, (FL: itself a LEO customer), before leaving to start a family.[19]

I also found a brief sketch about Betty that, I suspect, encapsulates the experience of many women at the time. She finished her schooling, and since the family did not have the funds to send her to university, she joined Lyons as a cost-accountant. She took and passed the aptitude test for LEO, despite the view of many of her colleagues, who saw working as a programmer as form of glorified clerical work, and a dead-end, with particularly poor prospects for women. Later, following the 'merger' with EE, she was featured in their advertising campaign 'Why pick a woman to pep up your accounting department?' This was then followed by the 'leering answer' (Abbate, 2012: 61) 'Some of English Electric Leo's best computer programmers are as female as anything'!

FL–The role of women in the development of computing has justifiably become a topic for study in its own right. Indeed, Marie Hicks in her book published in 2017 blames the exclusion of women from the higher ranks of computing for the decline of the British Computer industry. Dame Stephanie Shirley mentioned above, set up F International in the 1960s to allow women, often with young children, to develop software on a part-time basis and working from home. She deliberately shortened her first name and styled herself 'Steve Shirley' to circumvent gender discrimination. In many cases being invited for meetings with male senior executives who assumed she was a man, and who might otherwise not have given her the time of day.

*AB–Indeed, and ironically F International fell foul of a key UK government response to gender discrimination, the Sex Discrimination Act (1975), which meant that they could no longer recruit only women, but had to be open to anyone who wished to apply for employment. Shirley was also ahead of her time in offering employees flexible and decentralized working conditions. The Wikipedia entry includes a quote from Ralph Dahrendorf in a BBC documentary on 'Has Britain a Future?'*

> Some answers may be found in Party Manifestos. But the real changes are to be found where people live and work. F International has several characteristics which make it a model. It allows people to organise their own lives; it decentralises management decisions; it makes effective use of modern technology – and of course, it is successful.[20]

FL–When I first joined LEO, we received no formal training: we basically learned on the job and were mentored by one of the original team. It was akin to an apprenticeship, but much more concentrated over a very short period. As the number of recruits rose – very rapidly from about 1954/55 – it became essential to formalize the training, and special courses for programmers and engineers were established. Subsequently as LEO started selling its LEO II computer, courses for the staff of LEO customers became the norm. We still hear praise from former customers about the quality of these courses. Anyway, I joined the team and stayed until 1968, by which time LEO III had been developed.

LEO II was developed by 1954, at which point LEO was established as a subsidiary of Lyons, with Anthony Salmon, a member of the Lyons Board as its chairman. Setting up a subsidiary like LEO Computers Limited was not an unusual practice at Lyons for any aspect of the organization that was distinct from Lyons' main business in the food industry. Initially, LEO and Lyons worked closely with each other, but gradually, as LEO focused more closely on marketing its range of computers and its service bureau activities, the companies grew apart. At the same time, Lyons prioritized building successful applications to serve the Lyons business units rather than acting as a support as well as a shop window for its LEO subsidiary. The separation became more manifest when Lyons replaced one of its LEO computers with an IBM model. That decision created a good deal of resentment and some anger among LEO managers and staff.

Critically in 1963, the LEO project was taken over by EE. Technically, it was announced as a *merger* of the two, but in all respects, it was a take-over by EE. The EE people were very competent technically, but the LEO team were far more proficient in understanding the management and organizational issues involved in utilizing and harnessing this technology.

I should add some other details regarding LEO. Even in its earliest LEO I phase, the technology was not used only by Lyons. LEO I was also the basis for a service as a bureau. For instance, it was used by the Met Office (Hinds, 1981) and was the first UK use of computers for weather forecasting. It was also used by British Rail and the Ministry of Transport for calculating the distances between railway stations, since at that time, rail fares were meant to be based on the distance between departure and destination. A set of programmes was written to do this and run at night for several nights. The data were needed at this time since the number of stations had been reduced to 5000 for technical reasons. (See Roger Coleman's oral history in Professor Tim Greening-Jackson's account, Greening-Jackson, 2012; also, John Graham Cumming at the Strata Conference on Big Data October 2012. This use of LEO was nothing to do with the Beeching cuts, which came later.[21])

*AB–A recent episode of the UK TV series 'Endeavour', which is set in the early 1960s, offers a stark illustration of the time-scale for running computer programs at the time. The police are trying to find an address for someone whose name is known, but where there are no other details. They are offered the chance to make use of the new computer system installed by the GPO[22] (at that time in the UK the state-owned utility combining both phone and mail services). The search parameters are entered, then modified to make the search faster. The operator then announces he is off home for a good night's sleep as he does not expect any response before the morning at the earliest! Two people watching it with me, both under 40, could not believe that such a simple search could take so long.[23]*

FL–LEO in 1955 was also used to calculate tax tables, which changed after each budget (announced in March of each year). The Department of Inland Revenue provided the taxation rules for each category of income tax payer, and the LEO people wrote the appropriate programs, allowing for tax parameters to be changed at budget time. The Chancellor's statement was listened to with great trepidation, in case he introduced changes the programs could not deal with. A courier brought the new tax information to LEO, together with any parameter changes such as changes in allowances, and these were entered in the programs before the calculation of the tax tables. The output was then sent to Inland Revenue for checking and, if all correct, printing and distribution. The Department of Inland Revenue had commissioned LEO to do the tax table job in 1953 for the 1954 budget, but ironically in 1954 there had been no tax changes and LEO was not required.

Another LEO I project was running systems for the De Havilland company who were involved in various defence contracts. When LEO I was being used for these, it was physically roped-off, with only De Havilland staff and a select few from LEO allowed anywhere near the machine. Heading their team was Maurice Bonney whose career in some respects is a parallel to my own, albeit starting from and taking a very different trajectory; his initial work was using LEO I for calculations on missile technology, subsequently becoming chief programmer for a LEO III customer, Renold Chains, and later moving into Operations Management at Nottingham University, where he pioneered CAD/CAM methods, eventually retiring as Emeritus Professor.

## *Extract from Neville Lyons (FL: A distant relative of Joseph Lyons, who gave his name to J. Lyons & Co. Neville has no direct links to LEO, but is interested in the history of Lyons, and is an active member of the LEO Computers Society.)*

Bureau Applications Commence

> News of this 'electronic brain' spread throughout many industries and government departments and was received enthusiastically. Lyons soon organised a bureau, commissioned to perform a range of tasks on LEO. In fact, LEO undertook the first recorded bureau job on any computer in the UK; quite remarkable considering this was a prototype model! This task was on behalf of the Ordnance Board who were given facilities for carrying out ballistic computations. The work was shrouded in secrecy at the time, but it was later revealed that the calculations performed by the programming team were associated with the trajectories of the Black Knight rocket.
>
> Another large and more complex calculation job for the defence industries was undertaken on behalf of De Havilland and later revealed to be for simulations of the guidance system for the Blue Streak missile. One of the LEO team, Derek Hemy, who had a high security clearance having worked on Signals Intelligence during the war, did not become aware of its purpose until after he had left Lyons!
>
> In 1955, after the Chancellor's budget speech, a courier delivered to Cadby Hall the parameters of the new taxation. All other work had to be taken off the machine while LEO processed new tax tables overnight for delivery to Inland Revenue the following morning, a process that had previously taken weeks by hand. For the British Transport Commission, LEO worked out the distances between each of the 7000 goods depots, for the purpose of rationalising charges. This was the longest program and had to be performed over many evenings covering 18 months when LEO was not otherwise engaged. Had the job been undertaken manually, it was estimated that 50 clerks would have taken five years to complete it![24]

FL–As I mentioned earlier, one feature which made LEO stand out from the way other commercial organizations deployed computers was the level of ambition of the applications. A good example is the teashop ordering job rolled out in 1953 by the LEO team led by David Caminer; this was long before online technology became available.

*AB–some further details about LEO and the ways in which it developed, illustrating the ways in which LEO computers and the various applications programmed to run on the hardware encapsulate some of the key developments in the use of IT in the post-war period.*

Several of the LEO I projects are referred to in your chapter (Land, 1999), also in the section in Mike Hally's book (based on his Radio 4 programme, and then published as Hally, 2003). Later models, such as LEO III were in competition with the IBM 360, which became a standard for 1960s business computing. LEO III used transistors and incorporated micro-programming, based on the work of Wilkes in the early 1950s – he coined the term 'microprogramming' (Wilkes, 1951). In what became a seminal paper, he described an implementation of a control store using a diode matrix. Importantly, LEO III permitted a high degree of multiprogramming at a more advanced level than its competitors.

LEO III launched in 1961 and Caminer claimed that it was 2 to 3 years ahead of the IBM 360. The Post Office (GPO) was the best customer for LEO III, using a network of LEO 326s. The Wikipedia entry for LEO, largely derived from the LEO Computers Society website, has several details about the LEO III and 326.[25] LEO 4 was planned, but never built.

Once you had joined the LEO team, how were you brought up to speed to contribute to these various projects? I assume you had no experience with computers, hardware or software.

FL–All new members were assigned to a mentor. I was fortunate in being assigned to work with Derek Hemy, perhaps the best programmer I have ever met. My first job was working on checking his code. The team also learned a great deal from Wilkes and his colleagues in Cambridge. For example, we learned about the Cambridge range of mathematical subroutines, as well as the basic systems software such as the 'initial orders'.

Other key figures in these early days were John Grover, Leo Fantl and David Caminer.[26] Fantl was a refugee from Czechoslovakia, escaping as a 15 year old on one of the *kinder-transports*. He later enlisted in the RAF where among other things he gained some familiarity with electronics. At Lyons he worked in the Planning Department, and when the LEO team were looking for new member, they learned about his background and recruited him. Some of his early projects included the production of PAYE[27] tax tables, and also calculating the errors that arose from binary arithmetic operations.

*AB–I found an obituary on his death in 2000 where Fantl was described as 'The Father of Business Computing'.*

FL–I am afraid there were quite a few fathers. Just another example of myth making. Leo Fantl was significant, but his most important contributions were his understanding of the importance of recognising rounding errors and their impact, and later in establishing LEO in South Africa.. . .

*AB–The foregoing offers important insights into a ground-breaking era; adding further detail to your own writings, the work of the LEO group in general, and extended accounts such as those by Ferry (2003), Hally (2003), and Harding (2019). This should have whetted the appetite for readers keen to know more, also prompting others to offer their own accounts. All in keeping with your determination to ensure that the history – or histories – of these critical developments are articulated and made widely available. At this point, however, we need to move on to your subsequent activities as one of the founding figures of the IS Academy.*

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## Notes

1. More details are available from his oral history in the British library 'Other Lives' series – http://sounds.bl.uk/Oral-history/Science/021M-C1379X0017XX-0001V0
2. One of the primary objectives in presenting an oral history based on a single – albeit highly regarded and notable – person's recollections is to engender responses and prompt critical insights from others who can complement, supplement and challenge such accounts, adding new perspectives and insights.
3. http://whatculture.com/tv/10-incredibly-subtle-jokes-simpsons-might-missed?page=3
4. Follett's work has been largely overlooked, rarely appearing in collections on classic management writings and the human relations approach: yet another example of the ways in which women are all too readily written out of history.
5. Other links and materials can be found at the LEOpedia site – see http://www.leo-computers.org.uk/–In November 2018, the Lottery Heritage Fund in the United Kingdom recognized the importance of LEO, awarding funds to a joint project between the LEO Computers Society and the Cambridge Centre for Computer History, aiming to preserve and disseminate the lessons of the LEO projects and experiences.

Further recognition of the part played by LEO is the granting of a fund by the Heritage Lottery Fund to a joint venture by the LEO Computers Society and the Cambridge Centre for Computer History for the collection and archiving of LEO artefacts and memories, and the presentation of the LEO story to the public at large.

6. ENIAC Electronic Numerical Integrator and Computer' EDVAC Electronic Discrete Variable Automatic Computer
7. One reviewer asked for amounts in £sterling to be converted to US dollars, but readers need to be aware that this can be complicated since the exchange rate between the two currencies was US$4=£1 in the 1940s, and is now around US$1.2=£1. £3000 in the late 1940s was equivalent to US$12000, which equates to US$125,000 in 2019. £90000 is now worth around US$110,000 at current exchange rates – so in this case, there is only a moderate discrepancy.
8. Electronic delay storage automatic calculator https://en.wikipedia.org/wiki/Electronic_delay_storage_automatic_calculator
9. Lenaerts had been a clerk at Lyons before the War but had been trained on radar while serving in the RAF.
10. Institute of Engineering and Technology – https://en.wikipedia.org/wiki/Pinkerton_Lecture
11. International Computers Limited see https://en.wikipedia.org/wiki/International_Computers_Limited
12. The General Electric Company see https://en.wikipedia.org/wiki/General_Electric_Company
13. Ironically this phrase is now part of the conventional wisdom – quoted by many and referred to on many Internet sites – its original context now forgotten!
14. The Japanese in the 1980s, and the Chinese currently, also offer significant state funding and support to their digital industries.
15. The phrase 'accidental empires' springs to mind, taken from Cringley's essays on Silicon Valley (Cringley, 1992)
16. Standards Eastern/Electronic **A**utomatic **C**omputer – see https://en.wikipedia.org/wiki/SEAC_(computer)
17. The Wikipedia entry for Mary Coombs can be found at https://en.wikipedia.org/wiki/Mary_Coombs. Her father, William Blood, was the aptly named – or perhaps not – medical officer for J Lyons. Her story is recorded in the Oral History collection, *Other Lives*, at the British Library. http://sounds.bl.uk/related-content/TRANSCRIPTS/021T-C1379X0017XX-0000A0.pdf
18. A large number of women had been employed at Bletchley Park, mostly in important auxiliary roles, rather than cyptanalysis https://en.wikipedia.org/wiki/Women_in_Bletchley_Park. In the USA Grace Hopper played a very important role in early computer development, but was very much an exception.
19. http://ethw.org/Oral-History:Betty_Cooper
20. https://en.wikipedia.org/wiki/F_International
21. https://conferences.oreilly.com/strata/strataeu/public/schedule/detail/26214
22. The General Post Office https://en.wikipedia.org/wiki/General_Post_Office
23. http://www.denofgeek.com/uk/tv/endeavour/46411/endeavour-series-4-episode-1-review-game
24. http://www.computerconservationsociety.org/resurrection/res75.htm
25. https://en.wikipedia.org/wiki/LEO_(computer)
26. See the LEOpedia site – http://www.leo-computers.org.uk/
27. Pay As You Earn – the UK system for deduction of tax from one's income at source, as opposed to alternative systems where the tax is calculated at the end of the tax year.

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